

IODP Expedition 385: Guaymas Basin Tectonics and Biosphere

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Guaymas Basin is a young marginal rift basin in the Gulf of California characterized by active seafloor spreading and rapid sediment deposition, including organic-rich sediments derived from highly productive overlying waters and terrigenous sediments from nearby continental margins. The combination of active seafloor spreading and rapid sedimentation within a narrow basin results in a dynamic environment where linked physical, chemical, and biological processes regulate the cycling of sedimentary carbon and other elements. This continuum of interrelating processes from magma to microbe motivated International Ocean Discovery Program Expedition 385 and is reflected in its title, “Guaymas Basin Tectonics and Biosphere.”

During IODP Expedition 385, organic-rich sediments with sill intrusions on the flanking regions and in the northern axial graben of Guaymas Basin were drilled. Numerous technical innovations (for example, the sophisticated advanced piston corer [APC] and half-length APC) have greatly improved sample recovery and a total of 4176.2 m core (755 total cores with a recovery rate of 87.9%) in eight sites and 26 holes were recovered. Drill sites extend from the northwestern to the southeastern flanking regions of Guaymas Basin, covering an ~81 km long transect. Adjacent Sites U1545 and U1546 recovered the oldest and thickest sediment successions (to ~540 meters below seafloor [mbsf]), one without sill emplacement (Site U1545), and one with a deeply buried sill (~356-430 mbsf) that impacted the sediment column (Site U1546). Because the two sites are adjacent to each other (~1 km apart) and differ primarily because of the presence or absence of this large sill, they provide a model area for studying the consequences of sill emplacement into an older sediment column. A surprising feature of both sites was the strong thermal gradient that allowed us to recover continuous sample sets with in situ temperatures as high as 70°-80°C. Sites U1547 and U1548 are located in the central sedimented bowl and on the outer periphery of a circular hydrothermal mound called Ringvent, where a shallow, slowly cooling sill is driving steep hydrothermal gradients, which in turn shift the zones of authigenic mineral precipitation and compress the microbial abundance profile toward shallower depths. The thermal, lithologic, geochemical, and microbiological contrasts between the two deep northwestern sites and the Ringvent sites form the scientific centerpiece of the expedition. These observations are supplemented by results from sites that represent attenuated cold seepage conditions in the central basin (Site U1549), hydrate occurrence near the Sonora margin (Site U1552), complex sediments and sills in the northern axial trough (Site U1550), and terrigenous sedimentation events on the southeastern flanking regions (Site U1551).

The scientific outcomes of Expedition 385 will (1) revise long-held assumptions about the role of sill emplacement in subsurface carbon mobilization versus carbon retention, (2) comprehensively examine the subsurface biosphere of Guaymas Basin and its responses and adaptations to hydrothermal conditions, (3) redefine hydrothermal controls of authigenic mineral formation in sediments, and (4) yield new insights into many geochemical and geophysical aspects of both architecture and sill-sediment interaction in a nascent spreading center. The generally high quality and a high degree of completeness of the shipboard datasets presents opportunities for interdisciplinary and multidisciplinary collaborations during shore-based studies.

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